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Research Report 1785

Making the Transition from Analog to Digital Warfighting: Changes in Unit Behavior and Knowledge

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TRW Inc.

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U.S. Army Research Institute

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14. ABSTRACT *(Maximum 200 words)*:

This report documents an initial effort to investigate the transition from analog to digital operations at brigade level and below. We interviewed experienced digital warfighters—leaders and soldiers— to identify changes in unit behavior, knowledge, and attitudes resulting from experience with digital systems. Army documents relating directly to digital operations were also reviewed. The research team's subject matter experts analyzed the cumulative data to document insights and lessons learned. The findings revealed a systematic evolution of behaviors, knowledge, and attitudes accompanying the units' transition to digital systems and operations. Initial resistance and reluctance give way to confidence and trust in digital systems as leaders and soldiers acquire basic digital proficiency and then learn how to use the new technology to improve the warfighting process. Digital capabilities alter the way warfighters think and fight, and the operational changes find their way into procedural documents. As digitization progresses, leaders make bolder decisions due to excellent battlefield visualization and improved situational understanding. Planning, preparation, and execution of combat missions benefit from digital advantages. In parallel, the training environment evolves to support digital operations and readiness. The findings contribute to a knowledge base that will help facilitate the transition process in future digitized units. The findings point towards measures that can be used to assess Army and unit progress in making the transition to digital warfigthing.

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Digitization	Transition	Adaptation Process
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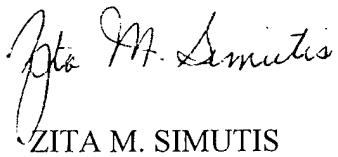
Personnel Performance and Training Technology

FOREWORD

The Simulator Systems Research Unit of the U.S. Army Research Institute for the Behavioral and Social Sciences conducts research to investigate the training requirements of the future force. This research unit supports the U.S. Army Training and Doctrine Command (TRADOC) and the U.S. Army Simulation, Training and Instrumentation Command (STRICOM) in defining current and future training requirements, developing performance measurement technology, and evaluating training concepts.

The U.S. Army is still in the early phases of the digitization process, and few units have had the opportunity to become "digitized." The receipt of digital systems is merely the beginning of the digitization process. Unit leaders and soldiers must gain experience using these systems in order to find out how to take advantage of system capabilities and implement the changes needed to gain these advantages. This research was conducted as part of a larger effort to develop measures of unit digitization and digital skills proficiency. This research was conducted by interviewing leaders and soldiers in digital units to identify changes in behavior, knowledge and attitude associated with experience using digital systems. The results of this research were briefed on September 5, 2001 to representatives of the Fort Hood Digital Training Facility, the III Corps Science Advisor, and the Warrior-T program.

This research established a knowledge base for understanding how units progress along the digitization path. More importantly, it created a foundation for documenting the unique skills and knowledge required for successful digital operations.



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MAKING THE TRANSITION FROM ANALOG TO DIGITAL WARFIGHTING: CHANGES IN UNIT BEHAVIOR AND KNOWLEDGE

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army is in the middle of an ambitious modernization campaign that relies heavily on digital technologies. The digital warriors of today and tomorrow need realistic training that enables them to fully realize the benefits of new digital systems on the battlefield. Such training requires specification of digital tasks and skills plus tools for measuring task/skill performance. The U.S. Army's First Digital Division (FDD) provides the prime repository of organizational experience regarding the transition to digital operations. The current research was conducted to document the evolutionary process of institutionalizing digital capabilities in the first digital division, with a focus on changes in unit behavior, attitudes and knowledge.

Procedure:

The research team combined interview and document review methods to gather information on the process and impact of transitioning from analog to digital operations. The interview audience included leaders and digital operators from one brigade combat team of the Army's first digital division. The interview questions addressed changes in unit behaviors and knowledge, the expected benefits of those changes, and warfighters' understanding of digitization and its impact on unit operations. The U.S. Army documents of interest included tactics, techniques, and procedures (TTP) and mission training plans (MTPs) prepared specifically for digitized units. The team's subject matter experts (SMEs) integrated the interview comments and the document reviews to produce insights and lessons learned.

Findings:

Despite a limited number of interviews, valuable findings emerged. First, progress toward digitization is reflected in warfighters' knowledge and attitudes. The knowledge base regarding digital capabilities and their operational impact is expanding rapidly. Warfighters initially need nudging, but their confidence and trust in their digital systems grow as they learn how to employ these systems and experience the benefits of employing these systems correctly. Digital capabilities are altering the way leaders think and fight, and the warfighting changes are being institutionalized in procedural documents.

As digitization progresses, leaders become more willing to take tactical risks as a result of improved battlefield visualization and situational understanding. Planning, preparation, and execution of combat missions all benefit from digital advantages. The training environment undergoes changes in order to better prepare leaders and soldiers to employ digital systems.

Utilization of findings:

This research establishes a knowledge base for understanding the adaptation process encountered by units starting along the digitization path. Equally important, it creates a foundation for documenting the unique skills required for successful digital operations. Finally, the characterization of digitization's operational contributions offers promise for enhancing the transition from analog to digital operations. Certain of the project's findings have already been incorporated in the Digital Leader Training program of instruction being developed under the U.S. Army Training Support Center's Warrior-T project.

MAKING THE TRANSITION FROM ANALOG TO DIGITAL WARFIGHTING: CHANGES IN UNIT BEHAVIOR AND KNOWLEDGE

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MAKING THE TRANSITION FROM ANALOG TO DIGITAL WARFIGHTING: CHANGES IN UNIT BEHAVIOR AND KNOWLEDGE

INTRODUCTION

This report describes research conducted under the project entitled, *Measuring the Evolution of Unit Digitization and Digital Skills Proficiency* . The research addresses the transition of U.S. Army units from conventional operations to digitized equipment and digital operations. Under the leadership of the U.S. Army Research Institute (ARI) Simulator Systems Research Unit, this project establishes a knowledge base regarding the adaptive behavior and skill requirements of units learning to accomplish combat tasks using digital capabilities of the Army Battle Command System (ABCS). The research goals were three-fold: (1) Describe changes in behavior of units as they digitize, along with the benefits and impacts of those changes; (2) compare battalion and brigade level activities to determine if new skill requirements emerge at brigade level; and (3) explore the measurement of skill proficiency level and how it relates to unit performance. This report addresses the first goal, to include indicators of digital proficiency. A subsequent report will deal with the second and third goals.

Organization of the Report

This report is intended as a guide for U.S. Army training researchers, U.S. Army Training and Doctrine Command (TRADOC) training developers, the Combined Arms Training Strategy proponents, and digital units beginning the transition from conventional to digital operations. It provides a baseline of information that is critical to the development of digital instruction programs at TRADOC, as well as installation and unit levels. Four chapters comprise this report:

- Chapter 1. *Introduction.* This chapter sets the context for the current effort. It explains the background, briefly defines the problem, and outlines the project's technical objectives.

- Chapter 2. *Method.* This chapter describes the methods followed for the current effort. It includes an overview of the sources of data, a description of data collection procedures used, and a summary of the approaches to data reduction and analysis.

- Chapter 3. *Findings and Discussion.* This chapter presents the findings related to the first project goal. It addresses the identified changes in unit understanding and behavior accompanying digitization, and then lays out the expected benefits of those changes. It also describes challenges identified by units that need to be addressed to facilitate the use of digital systems.

- Chapter 4. *Recommendations and Conclusions.* The final chapter suggests actions that U.S. Army agencies and units can take to facilitate digitization. It also addresses potential indicators of digital proficiency and distills the major themes discussed in the report.

Background

The U.S. Army is transitioning its warfighting capabilities from its traditional analog focus to digital platforms and Tactical Operations Centers (TOCs). The U.S. Army has a number of automated data processing systems which support military operations. To a large extent, each system was designed to perform functions for a particular staff section, known as a Battlefield Operating System (BOS). A BOS is a set of related critical tactical activities which are grouped together for closer coordination (Department of the Army, 1997). The Maneuver Control System (MCS), the Advanced Field Artillery Tactical Data System (AFATDS), the All Source Analysis System (ASAS), the Combat Service Support Control System (CSSCS), and the Air and Missile Defense Warning System (AMDWS) support the maneuver, fire support, intelligence, CSS, and air defense BOSs respectively. These systems are usually employed in a TOC environment. The Force XXI Battle Command Brigade and Below (FBCB2) system supports the dissemination of information to and from individual platforms, such as tanks or infantry fighting vehicles.

Although each of these digital systems was developed independently, they are capable of sharing data over a network (TRW, 2000a). Because interoperability exists among these systems, they are considered subsets of an overall digital system (i.e., a system of systems). The term ABCS encompasses all of these systems. To make sure that these systems work together, and to correct problems identified in user testing, each individual system has progressed through a number of versions. The U.S. Army is expected to continue the evolution of these systems..

In leveraging information age technologies, the U.S. Army must redefine itself. The battlefields of the 21st century will rely increasingly on information technologies to acquire, exchange, and employ timely information throughout the battlespace (e.g., U.S. Army Training and Doctrine Command, 1994). Digital command, control, communications, computers, and intelligence (C4I) technologies such as the ABCS promise substantially improved warfighting capabilities. Total employment of these systems is expected to produce faster decision cycles, greater flexibility for leaders, better targeting, and greater control over tactical situations. Getting the most out of the digital systems requires basic understanding and training on those systems plus the understanding of the digital tasks and supporting digital skills needed by soldiers and leaders. For the potential of digital systems to be realized, leaders and soldiers must, through trial and error, identify the best ways to operate and employ these systems..

Effective use of digital weapons platforms will improve warfighting capabilities. Units are being fielded more and more digital systems daily. Soldiers and leaders are expected to become more proficient operating digital devices and employing their capabilities. Over time, experience with digital systems will result in validated tactics, techniques, and procedures (TTP), unit standing operating procedures (SOPs), and improved descriptions of digital training requirements. This metamorphosis from analog to digital will take time. Digital systems will continue to evolve, probably at a faster pace, in an attempt to maximize the benefits of advancing information technologies. The "spiral development" process (Dierksmeier et al., 1999) compels units to (1) maintain currency on changing systems (updated hardware and software) and (2) incorporate training program or technology improvements into their training in incremental phases. The spiral development process of technology advances and TTP modifications continue to positively influence each other. For example, units were encouraged not to acknowledge

receipt of messages with the early versions of FBCB2 in order to reduce message traffic. However, the soldiers sending the messages wanted to ensure the messages were received, so they would send the message several times. Due to lessons learned, the capability was developed to automatically acknowledge the receipt of a message, depending on what the originator requested. The technology continues to spiral but the training continues in a "stand, walk, run, analyze, and refocus" cycle.

After observing the preparation of the 1st Brigade Combat Team (1st BCT) of the First Digitized Division (FDD) for the Task Force XXI Advanced Warfighting Experiment, BDM Federal, Inc. (1997) described how warfighting activities of digitized units differ from those of analog units. These "Do Differents" were the first of a series of Digital Operator's Guides, tactical SOPs, and digital doctrinal manuals for ABCS users and staffs (TRW Inc., 1999a , 2000a, 2000b). The guides' detailed procedures were found to be effective for utilizing digital platforms and provided a starting point for defining how units can adjust to digital capabilities. The SOPs and manuals assisted the units with descriptions on how to fight in a digital environment. The spiral development nature of the Army's transition to digital systems makes the information contained in the documents obsolete or, at best, not current with the latest software versions as new versions are fielded periodically.

Warrior-T, an U.S. Army Training Support Center training development integrator at Fort Hood, has recently completed an extensive review of tasks for the current ABCS software versions. The Warrior-T website can be viewed at http://fioasat.hood.army.mil/index.html. Their product (ST 20-101-5-ABCS [draft]) is a combined listing, by staff section and BOS, of the various collective tasks required of digital users today (Warrior-T, 2001). This listing provides a baseline of tasks for use by TRADOC schools and researchers alike as the U.S. Army explores changes associated with digitization. Most important is its seeming resilience in the face of spiral development.

To date, only the 4th Infantry Division (4ID) has employed digital systems across the BCT level. The 4ID's 2nd BCT recently completed a digital rotation at the National Training Center (NTC) as part of the Division Capstone Exercise (DCX), Phase I. The leadership of both Fort Hood brigades and much of the divisional structure has moved to new assignments since the April 2001 DCX. Traditionally, such a transition period has resulted in a refocusing of priorities as new leaders assume command. Fortunately, senior leaders who participated in the Division's earlier digital transition are returning. Because of this, we anticipate a shorter and less turbulent transition and increased stability in digital operations for the Division. This facilitated the Division's preparation for the DCX Phase II, which occurred the fall of 2001.

As the FDD begins to reach stability in digital operations, providing a sound basis for identifying digital tasks, skills, and knowledge critical to training soldiers and leaders, the second division to digitize has begun the transition process. The First Cavalry Division (1st CD) is transitioning the first of three brigades to new digital weapons platforms.

As the digitization process continues many of the same digital tasks will be performed across missions and BOSs. The building block skills—for example, creating and distributing an overlay—are the skills of interest for this research. We are trying to avoid examining skills

required to employ specific operator interfaces, because these interfaces can change at any time. The example may have the features of a skill (i.e., retained across digital systems and software versions, applicable across tasks, and not highly perishable), or it may be comprised of a group of skills or a group of tasks.

Problem Definition

The digital warriors of today and tomorrow need realistic training that enables them to fully realize the benefits of digital C4I systems on the battlefield. Such training requires specification of digital tasks and skills (in TTPs , MTPs and TSPs) plus tools for measuring task/skill performance. The spiral development environment complicates the challenge of meeting training needs and developing digitally focused TTPs. The training environment is shaped by complex new technologies (systems of systems) where hardware and software change rapidly. As the U.S. Army's first digital division, the 4ID provides the prime repository of organizational experience regarding transition to digital operations and documentation of digital tasks and skills. The current project was designed to document the 4ID's evolutionary process of institutionalizing digital capabilities, with a focus on behavioral changes and digital skills that enable the unit to fully exploit the power of advanced C4I systems.

Technical Objectives

The following technical objectives guided the current research:

- Describe changes in the behavior of units as they gain experience using digital systems.
- Describe expected benefits of changes in the behavior of units associated with digitization.
- Describe changes in unit understanding of digital skills, the value and role of digitization, and the need for additional guidance regarding system operation or employment.
- Assess whether new digital skills emerge at brigade level.
- Examine the use of multi-value versus all-or-none measures of digital skill/task proficiency.

This report addresses the initial three technical objectives comprising the first phase of the project.

METHOD

The purpose of this phase was to capture the attitudes and thoughts of the FDD warfighters to establish a foundation for future digital training. The focus was to determine the effects of digitization on the FDD and identify the benefits associated with the unit's transition. Changes in warfighters' understanding of digital skills, the value and role of digitization, and the need for additional guidance regarding system operation or employment were also of interest. The initial step was to review pertinent Army documents to determine how the threads of digital training were being woven into the Army's training system and literature. The document review was to be followed by observing digital operations first-hand and capturing the reflections of leaders and soldiers in the Army's FDD as to the benefits and value of having the digital capabilities. Finally, multiple interviews before and after their DCX participation were planned.

Due to circumstances beyond the team's control, the opportunities to observe digital operations first-hand did not materialize. The interviews were limited to selected leadership in the 4ID's 1st BCT, which had not participated in the DCX Phase I but had been the first fully digital brigade at the NTC in Fall 2000. The result was adequate, if not optimal, information. Understandably, obtaining warfighter participation in research was more difficult for decisively engaged units. The research team compromised in collaborating with the FDD, gleaning the essence of the division's experiences.

Data Collection Procedures

Interview Participants and Procedures

The research team's SMEs interviewed the 1st BCT, 4ID leadership at Fort Hood during the week of April 2-6, 2001. The target audience included a brigade and a battalion Commander, Executive Officer (XO), primary staff (S1, S2, S3, S4, S6), special staff (Fire Support Officer [FSO], Engineer, Air Defense Artillery [ADA] Officer, Analysis and Control Team [ACT] Chief), and selected maneuver company commanders, platoon leaders, and ABCS operators.

The interview team consisted of two SMEs serving as facilitators and one note-taker at each interview session. In order to structure the interviews, the facilitators used an interview guide containing general instructions and questions of interest (Appendix A). The interviews were tape recorded for later transcription. Each session lasted approximately 2 hours, whether one-on-one or group interview.

The interview process addressed all BOSs with emphasis on digital tasks and their supporting digital skills. Interviews were designed to capture objective, behavior-based evidence of unit transition to digital operations and insights of leaders and soldiers. The intent was to garner a reflective view of digital transition, gather data from the 1st BCT's NTC experience, and identify specific digital tasks that require further study. Additionally, interviews probed for:

- Digital skills identified by unit leaders and soldiers.

- Digital skills acquired that are independent of specific software versions of digital systems.
- Requirements for additional guidance on how to implement digitization or perform certain digitization skills.
- Requirements for better feedback on individual or unit progress.
- Problems adjusting to digitization and the means for overcoming them.
- Emergence of new digital skills at brigade level.
- The value of digitization.
- Digital skill proficiency determination concepts.

A transcript of each interview session was prepared from the tape recordings, with the aid of notes taken during the session. Each transcript was reviewed and edited, as appropriate, by the interview team to produce an accurate record. Table 1 outlines the interview schedule for the 1st BCT participants.

Table 1

Fort Hood Interview Schedule (1BCT, 4ID)

Time	Audience
Day 1	
1000-1200	Brigade Staff (XO, S1, S2, S3, S4, S6, FSO, Eng, ACT, ADA)
1300-1500	Company Commanders (2 Armor, 2 Infantry)
Day 2	
0800-1000	Maneuver Battalion Commander (1/22 Infantry)
Day 3	
0800-1000	Platoon Leaders (2 Armor, 2 Infantry)
1000-1200	Maneuver Battalion Staff (1/22 Infantry, all principals)
1300-1500	1st Brigade Commander
Day 4	
1000-1200	Maneuver Control System Operators
Day 5	
1000-1130	Maneuver Battalion Commander (1/66 Armor)
1130-1330	Maneuver Battalion Staff (1/66 Armor, all principals)
Day 6	
0900-1100	ASAS-RWS, AFATDS, and Maneuver Control System Operators

Interview Questions

Questions for the interviews are contained at Appendix A. Interviews addressed the unit's training and sought key information related to the relationship between digital training and required skills, abilities, and task proficiencies. Interviewees were instructed to answer questions using their areas of expertise as a reference point. For instance, the S2 answered questions relating to intelligence tasks and issues as they pertained to the evolution of digitization and digital skills proficiency in the intelligence area. Likewise, company commanders spoke to specific tasks and issues relating to company and platoon level requirements.

Document Review

The team also reviewed relevant literature and programs, all of which were bound by their practical utility to this effort. The selected literature (listed in Appendix B) dealt with Force XXI and digital guidelines, policies, and procedures, conventional training doctrine, and innovative approaches to training, especially staff training. Reviewers were directed to analyze their assigned references, distill digital tasks and skills, and synthesize ideas and common threads of continuity pertinent to digital skills proficiency. These listings of common digital tasks and skills were compared to the interview findings to enhance their credibility.

Data Reduction and Analysis

The interview data was organized into two distinct domains—(a) behavior and attitude changes and (b) tasks and skills. Because the interview protocol had been constructed to specifically address the digital technical objectives for the current project, responses speaking to behavior/attitude changes were sorted into categories. These categories were: changes in unit attitudes and behavior as a result of digitization; the operational impact of digitization; and benefits of digitization. The team's SMEs independently reviewed each transcript and extracted bits of information representing insights and lessons learned. The independent review products were then consolidated and the reviewing team met and prioritized each key digital transition finding. Where necessary, the team combined findings and resolved differences of opinion, finally reaching consensus on the integrated findings. A similar process was followed for reducing the information from the documentation review. Various SMEs extracted lists of skills and tasks from documents.

The data was drawn from reviews of various documents (see Appendix B) and interview comments from the 1st BCT, 4ID. Each SME reviewed the pertinent documents looking for specific information related to this research effort. The SMEs' participation in the interviews enabled them to better understand the flavor of the specific comments. In addition to individual interview notes, an unfiltered copy of the verbatim interview transcripts was provided to each SME analyst. The team assembled and discussed the various findings and determined which were noteworthy, in terms of the variables of interest. The subjective nature of the data did not support formal statistical analysis, and the small population that makes up experienced digital leaders at various levels also frustrates efforts to perform statistical analysis. The analysts next shared a printed "findings and discussion" draft in bullet format to determine which category the pertinent data fit best. Subsequent to that analysis the major findings were elaborated for each of

the three technical objectives, with the SMEs injecting their own knowledge and insights where appropriate. The cumulative findings will be discussed in the following chapter.

FINDINGS AND DISCUSSION

This chapter presents and discusses the specific findings that resulted from the warfighter interviews and document reviews. It is divided into the following sections:

- Positive Changes in Unit Behavior
- Positive Attitudes Regarding Digitization Impacts
- Expected Benefits of Changes in Unit Behavior
- Digitization Challenges
- Summary of Findings and Discussion

It is not the goal of this report to provide an assessment of how far any unit, or the U.S. Army as a whole, has progressed along the digitization path. Instead, the goal is to develop information that can be used in deciding what events the U.S. Army may want to measure in examining digitization progress. For example, a number of leaders told the research team that friendly platform location data provided by digitization removed one of their most time-consuming combat tasks (i.e., using voice communications to gain information about where subordinate elements are located and what they are doing). Certain of these leaders pointed out that gaining this benefit required substantial training and command emphasis to make sure that all platforms broadcast their locations. These findings alone immediately suggest three measures of digitization progress. Is voice traffic concerning the status of platforms and units greatly reduced? What percentage of platforms within each unit are successfully conveying location data to higher headquarters? What command policies encourage leaders and soldiers to make sure a high percentage of platforms are effectively transmitting their location data?

The small number of interviewed for this effort makes a quantitative analysis of data impractical. Instead analysis of comments made by experienced digital leaders and soldiers tend to focus on insightful comments that suggested a change in behaviors or attitudes that might occur as a function of digital experience. For example, a brigade S2 described how the focus of the commander's questions shifted from what is the enemy situation to what is the enemy doing.

Positive Changes in Unit Behavior

We identified changes in the behavior of units resulting from experience in using digital systems. These changes were based upon comments made by experienced digital leaders and soldiers during the interviews conducted for this project. In certain cases the descriptions of the behavior changes have been enhanced by adding comments from other, identified sources.

Certain changes in behavior take the form of unit policies that were established to promote and support the use of digital systems. Most of the behavior changes concern the way units fight and/or increased warfighting capabilities. These changes did not result automatically from the availability of digital systems. They resulted from the lessons learned by units in attempting to employ their digital systems.

Command emphasis fosters positive attitude changes. Commanders at brigade and battalion level felt that it was beneficial to press subordinates to use the ABCS systems rather

than assuming subordinates would learn by self-exploration. Soldiers preferred to take a cautious approach initially. The commanders had to drive the acceptance of digitization within their units. Once soldiers were trained on the systems and used them during a field exercise, they bought into the concept. Some commanders were adamant about subordinates having all digital systems on line before they crossed the line of departure (LD) during training. Subordinates initially felt that their training was being held hostage by their digital systems. This changed with the understanding of what the systems could provide them (e.g., improved situational awareness). When they realized they could see everyone around them, where their units are and where the enemy is as a result of spot reports, they became more comfortable with the digital systems and believed in their utility. Units where the commander permitted his subordinates to train on the systems as they had free time reported insignificant progress in understanding ABCS systems and continued to fear the perceived disadvantages of digitization. Without trust in their systems, soldiers and leaders created more work for themselves. They took digital information and converted it to analog formats. This added to the distrust of digitization, workload of soldiers, and negative attitudes toward digital transition. Leaders had to be very direct in the way their soldiers were trained on these digital systems. They found that soldiers, left to their own choices, would not focus on the "new" systems, but rely on traditional analog methods.

Commanders reinforce digital broadcast rates. This motivational measure was implemented to speed the acceptance of the systems. One battalion commander would not let his units cross the LD unless the unit had 95 percent of its systems operational and broadcasting via FBCB2. He motivated the units by tying broadcast rates to their return to garrison. A unit with the highest broadcast rate was the first to go in. A unit with the worst was last. He also presented Army Achievement Medals to crews that maintained 95 percent or better broadcast over a certain number of days. He rewarded people who used their systems and kept them operational. By keeping their systems on line and broadcasting, the commander knew subordinate locations without voice communication.

Obtaining information regarding the percentage of FBCB2 systems that were operational during an exercise involved developing software that collected data from the tactical internet manager and prepared a report tracking broadcasts by bumper number. Sample output shared with the research team showed that, on a particular day, 114 systems were in the task force, 102 systems were available for use, and 88 of the 102 systems were operational. The results of the automated analysis, by bumper number, were made available to leaders and soldiers on the unit's homepage.

Commanders do not rely exclusively on their digital systems to control their subordinates. The brigade commander and subordinate commanders used a combination of digital, voice, and face-to-face communication to ensure their subordinates understand missions and how to carry them out. There may be times when commanders feel there is a need for personal emphasis in planning that must be done face-to-face with subordinates. When commanders send an operations order, they may want to ensure through face-to-face coordination that subordinates understand the commander's intent. Commanders may send an order digitally and then follow up with a face-to-face stressing the importance of their intent; thereby ensuring subordinates fully understand the commander's perspective. Circumstances

dictate the best means of communication. As one commander put it, "You're not able to calm anyone down digitally. You can do that face-to-face. You can put both hands on the guy's shoulders and say you're doing good or, if you screw that up again, I'm going to have your rear. You can't do that digitally, period. You can only do it face-to-face." This attitude needs to be compared with concern expressed by leaders during the Force XXI Advanced Warfighting Experiment that digitization was forcing them to give up face-to-face communications.

Commanders alter the way they fight. When digital systems were combined with motivated, well-trained soldiers and digital SOPs, Task Force commanders changed the way they fought. The way they thought tactically changed. They felt they could take more risks and make bold, aggressive, and proactive decisions because they had accurate, timely information from their ABCS systems. A good example of altered warfighting practices involves the sequencing of critical battlefield functions. Historically, commanders have planned and executed an intelligence-maneuver-fires sequence to optimize the application of conventional assets. However, the superior targeting capabilities of battlefield sensors and digital systems is responsible for an emerging shift to an intelligence-fires-maneuver sequence. Specific ABCS-related factors contributing to this trend appear to include the greater speed of relocating fire support assets, more precise triggers, and greater accuracy of fires.

Units use digitization to improve and control tactical movement. The situational awareness capability of FBCB2 enables leaders at the lowest levels to navigate with precision. Additionally, FBCB2 is used to control unit movements. One company commander talked about using FBCB2 at the NTC. He spoke about how blind he was inside the vehicle turret and how hard it was to see what his subordinates were actually doing. He stated, "With FBCB2 I could actually tell them, 'No, turn your platoon around or turn left or turn right.' I actually had the ability to command them without having to have eyes on or constantly be on the radio receiving updates from them."

The commander's priority intelligence requirements (PIRs) are more focused and visible. In the traditional analog fight, the PIRs were visible to planners and reconnaissance forces, but only somewhat to soldiers in companies and platoons. As a result of information sharing, digitization makes PIRs visible at all levels. The information pertaining to the PIRs is simultaneously updated across the command. With digitization the PIRs can be quickly adapted to accommodate changing battlefield requirements. Thus, PIRs may change as the battle unfolds, which is not typical of analog operations. Lynch (2001) also reported on the importance of PIRS and their fluid nature,. based upon his early experience as a digital leader.

The more information available, the more leaders want tailored information. At the brigade staff level, it was reported that the volume of ASAS and FBCB2 information is mind-boggling. Battlestaffs receive much more information with the digital systems. The tendency at the task force and brigade staff level is to pass what they receive without filtering much at all. With so much information at task force and company levels it takes too long to extract what they need. Instead of a shotgun blast of information, the company commanders want information sent to them tailored, so they only receive what they need. Commanders will continue to stretch these digital information systems to exploit information advantages. Instead of raw intelligence, the commander expects grounded intelligence summaries justifying the enemy's intent. He is not

satisfied with where the enemy is, but wants to know what the enemy will do next. The commander's questions are more specific than his analog counterpart's.

The decision making process is strengthened. Digitization provides real- or near real-time information on which to make decisions. Leaders receive more accurate information faster, allowing them to think ahead, evaluate more courses of action (COAs), and get more precise orders out. The enhanced situational understanding enables leaders to move more boldly against the enemy and transition the battle more aggressively. On the surface, a greater willingness to take risks seems apparent, but greater confidence and precision offset the risk.

Commanders seem more willing to take risks. More than once commanders reported that, because they could see where their subordinate units were, they felt confident in making critical tactical decisions. Their confident visualization expedited the flow of the battle and had significant benefit in exploiting or transitioning the fight. One commander stated about a mission at the NTC, "Where you have a high level of confidence with your situational awareness in an area of risk, you are probably more prone to go. We're always looking for risk taking. I had one company commander whose mission was to occupy a tier to the south of Brigade Hill. And I told him if the commo went down, you go there, if it's smoked or has been slimed, you go there. No matter what, you go there. Now, going through Brown Pass, there's a lot of smoke and a lot of dust, very unsafe, but he went through there at 30 to 35 mph to get to his destination. You come out of those twisty wadis and all of a sudden you are out in the open. You can become very disoriented but with the digital capabilities you know where you are and are able to get to your objective." It is important to point out that, even though icons show the location of a specific platform over a map display, some leaders and soldiers will continue to get lost on the battlefield.

Commanders use enhanced situational awareness to boost control of tactical operations. Commanders have digital resources available to validate their location and the location of subordinates and enemy forces. They are no longer dependent on a track commander's or platoon leader's ability to read a map. They are dependent on the same track commander or platoon leader to maintain his FBCB2 on-line and transmitting. For example, leaders use their digital situational awareness to facilitate passage of lines and in breaching obstacles. By knowing the exact locations of friendly vehicles the coordination and synchronization involved in passage of lines is significantly eased with much less chance for fratricide. Also, by knowing the exact locations of obstacles, the intricate coordination and guides required in the analog breaching process are greatly reduced with much less risk. From the brigade commander level down through the platoon leader level , leaders appreciate the significance of the general capabilities enabled by improved awareness of the tactical situation.

Situational awareness gives digital units a warfighting advantage in reduced visibility operations. Because of the ability to maintain accurate awareness of vehicle locations, both Blue and Red, as well as the terrain in nighttime, fog, smoke, and other reduced visibility conditions, digital units have a tremendous advantage. This advantage, when coupled with the weapons-range advantages of advanced tanks and Bradleys, could change tactics in a limited visibility environment. Clearly, digital units have a decided advantage under conditions of reduced

visibility. They can now really fight at night. Again, an appreciation of this capability extends from brigade through platoon level.

Logistics coordination and support are improved by digital capabilities. Several examples were cited. Company commanders said FBCB2 was a great navigation tool because they knew where the fuelers and M88s (retrieval vehicles) were and they knew where their own people were. The result was more synchronized link ups. Medical evacuation linkups happened more quickly, thereby reducing the number of battlefield deaths (simulated). With their FBCB2 platforms, logistical personnel arrived at the proper location without the traditional battlefield confusion. This was particularly valuable when the battlefield was fluid and units were moving frequently.

Leibrecht et al. (in preparation) also describes positive impacts of digitization on logistics. Digital tools have enhanced casualty evacuation procedures on several counts. The unit can send precise locations of casualties. The medic knows where evacuation assets and available treatment facilities are located. The digital systems feed the medical supply network. These capabilities lead to faster evacuation, faster treatment, and better allocation of medical resources.

Digitization gives commanders more time to think. Commanders reported that they could more quickly determine synchronization problems, resolving them faster and with greater precision. This reduced the distractions and provided more time to think. One battalion commander characterized this time as "white" time. This commander said, "Being digitized, the task force and company commanders (and to some extent the platoon leaders) are free to think about actions on contact, and the enemy, because now you're not on the radio all the time trying to get information. You are able to build time [white time] into the tactical calendar in order to think. I'm not asking that company commander, 'Have you started to move? Are you on route? What's your status?' I'm now watching that on a digital display. At the same time I start to think about the threat on the flank or the continuing pressure on the front, or contingency operations that may occur later. So it buys time for both levels of commanders, battalion and company, to think. This provides me time to think and relieves the stress of the battle. It can slow the pace down to allow commanders to do what commanders ought to do, which is think, instead of being an information processor." This positive change in behavior is one reported at brigade and battalion command level.

Digitization enables planning around multiple COAs. Although digitization has not made planning (the formal Military Decision Making Process [MDMP]) any faster, it has improved flexibility, precision, and synchronization. With the increase in information, there is now more detail in planning. By having more information faster, the planners are not tied to one COA. They have the ability to wargame multiple COAs and have greater ability to change COAs during a battle. Units are able to change or adjust their actions quickly and decisively. There is also a more fluid transition between missions. Staffs take more accurate information, analyze it, and develop a plan, or several plans. The Battle Planning and Visualization (BPV) tool provides the capability to simulate a plan so that commanders can, potentially, reinforce their decisions with objective probability of success in addition to command experience. With the accurate, timely, precise information that digital systems provide, commanders have the ability to develop

bold and aggressive COAs to strike the enemy and defeat him. They can also develop plans with branches and sequels to take advantage of resources in the most efficient and practical manner. Because commanders can now see the battlefield with near real-time awareness, they can alter COAs far more quickly with greater effect. Though planning is not taking less time overall, digitization allows more precise planning and more COAs to be explored and rehearsed. The commander has much more flexibility.

Better situational understanding results from better situational awareness. More accurate and more timely battlefield visualization becomes the norm, with the common relevant picture of the battlefield being shared vertically and horizontally. The sharing of real-time information promotes higher levels of analysis across the BCT with a more robust environment for understanding the enemy's options and likely COAs. Digitization is transforming the tactical environment for planning, preparing, and executing combat missions.

Digitization gives leaders the ability to take bold and aggressive actions. Many commanders in 1st BCT, 4ID used digitization's shared visualization of the battlefield to achieve an increased confidence and ability to make bold and aggressive decisions. The ability to see actual subordinate locations enabled leaders to avoid redundant voice communications. Once subordinates began to use the digital systems, the commander had the ability to obtain information, analyze the information, make his decisions, and get those decisions out faster than he had before—with better clarity and understanding of his intent. Commanders reflected that they had more "white" time to strategize and make decisions as a direct result of digital awareness.

Positive Attitudes Regarding Digitization Impacts

Unit experience with digital systems also resulted in changes in attitudes regarding those systems, as well as changes in a unit's understanding about how to employ them and the effort required to enable the employment. Again, these changes in attitude and understanding were the result of warfighter efforts to employ digital systems.

Commanders believe that enhanced situational understanding is the primary value of digitization. Digital systems provide accurate, real- or near real-time information the commander needs to engage and defeat the enemy. During a battle, leaders see what is happening as it happens. They are no longer tied to the FM radio, trying to pull information from the forces that are engaged. In a sense, the commander is now "on" the battlefield, watching his elements maneuver and engage the enemy. Units now have the capability to make better-informed decisions not only in the planning stages, but as situations develop on the battlefield. Commanders can develop plans with precision and confidently alter COAs as the battlefield changes.

Familiarity and proficiency breed confidence in digital systems. As soldiers become proficient in their skills, they build confidence in their systems, which facilitates leaders making sound decisions. Once the capabilities and limitations are understood, soldiers exploit digital systems to defeat enemy forces. As the unit becomes proficient digitally, warfighters discover new and better ways to use the tools, as well as ways to improve them. The result is another

spiral in the transition process. Soldiers and leaders need to understand that this process is beneficial and must continue.

Confidence in digital systems increases with experience. Commanders interviewed were of the mindset that digital training distracts soldiers from training in their basic warfighting skills. Because they lacked confidence in their system's capabilities, they felt their soldiers still needed to train on how to read a map, use a compass, create a range card, etc., thereby doubling their training requirements. Once the soldiers became proficient with the systems and the leaders understood their capabilities, they gained confidence in the systems. The perceived burden of using the systems was lifted and units became more efficient and skilled at accomplishing the mission with their digital systems. The outcome reflected a new synergy between digital skills and warfighting skills.

Trust in digital systems comes with seeing their benefits. As units gained more experience with their systems they began to trust them. One of the ways commanders encouraged their subordinates to use the digital systems was to forbid the use of paper maps. Basic map reading skills were still required, but subordinate leaders quickly determined that automatic updating of weapons platform locations enhanced their situational awareness and provided a more reliable monitoring and planning capability. A company commander knew when his platoons were prepared to attack. The commander knew when a subordinate had failed to move or had strayed from the planned COA. Another major advantage of using the digital systems was the ability to fight in limited visibility. Warfighters have the ability to "see" the terrain on their screen, to know where they are, to know where the enemy is, and to know how to get where they want to go. They know what they must do to successfully accomplish their mission. Digitization provides a distinct advantage over the enemy. Units now have the ability to maneuver and engage the enemy when and where they choose.

Training at the NTC reinforced the value of digitization. Even though the 1st BCT, 4ID primarily used only the situational awareness and ASAS aspects, they appreciated the leverage that it provided them in the NTC's warfighting environment. Their training center experience with digital systems has been favorable, boosting trust and confidence.

Leaders now recognize the value of icon propagation. Knowing where both Blue and Red forces were on the battlefield appeared to be one of the most positive aspects of digitization. The automatic propagation and following of the icons saved a lot of radio transmission time. As one company commander stated, "I've maneuvered the company with it now and it was awesome. You don't have to go 'Red 1, Red 1, Steele 6, SITREP [situation report], what's your location?' You look at your screen and you see him. You know what his orientation is. You take a second to get your screen oriented. All those doctrinal things we talked about when you're in bounding overwatch or traveling overwatch and you're supposed to kick the lead platoon out 1000 meters—we never did that before being digitized. You just didn't have confidence in where those guys really were. But when I was digital, I moved two up and one back almost all the time because I knew, even if I couldn't see, that the other platoon was abreast of me. Digitally I've got them on FBCB2. So, I love it. To me it's really helped."

Digital skills and knowledge will eventually be career-sustaining. At the present time, there is a high probability that a leader or soldier will go from a digital unit to an analog unit. For this reason, the skill acquired through digital training are unlikely to be employed at the next duty station; however, as more and more units become digitized, the career value of digital skills will increase. When an enlisted soldier progresses through the ranks, he will go from an ABCS user or operator, be it FBCB2 on an Abrams tank, Bradley, High Mobility Multipurpose Wheeled Vehicle or an Army Tactical Command and Control System operator as a private first class or Specialist in a unit command post, to a section sergeant, non-commissioned officer in charge, or Platoon Sergeant. He will carry the basic knowledge from his experience to do his job more efficiently, with confidence, and with a better understanding of how the digital systems work, alone or with other systems. Likewise, as a unit First Sergeant (1SG), he will have the benefits of knowing the data sources for all of the consolidation reports that he now submits as part of CSSCS functions.

Likewise commissioned officers will carry FBCB2 digital skills learned as a platoon leader as they progress to higher levels of command and responsibility. They will have the basic foundation of the digital architecture and will be able to expand that base to higher levels of action and responsibility. They will be comfortable and confident with digital information.

Expected Benefits of Changes in Unit Behavior

The benefits discussion that follows is based on this research with additional information drawn from the research team's digitization experience and expertise. It is by no means comprehensive; rather it highlights areas that are from the team's perspective the most prominent. A critical aspect of the team's experience is that units have moved from trying to get the digital system into operation to trying to attain the benefits available from digitization. Through gradual improvements, individual systems have become more robust, and improvements have been made in the capability of systems to communicate information to other systems. By and large, the digital "system of systems" has matured to the point that it works as a tool for the warfighter. The first benefits to be highlighted are associated with planning and preparing for operations. Several leaders have termed this the "transition" capability associated with digitization. Then the constructs of Situational Awareness, Situational Understanding and Situational Dominance will be used to describe a hierarchy of benefits.

Planning and Preparing for Missions

Transition to the next mission is more rapid and effective. The Army has long practiced a one-third/two-thirds rule for headquarters concerning the time they take to develop a plan and then provide the plan to subordinate units for planning and execution. This standard is simply no longer appropriate. Digitally equipped headquarters, upon receipt of an order or alert to change mission, immediately (within minutes) alert their subordinates. The electronic messages contain the orders (more concise than before), overlays with graphics (simplified), and the commander's intent. Compare this to the conventional process of sending liaison officers to the subordinates' command posts or having the subordinate commanders come to the headquarters command post for a briefing and then take the briefing and orders back to their own command posts. Subordinate units have substantially more time to prepare for the mission as staffs plan for it in

parallel. In essence, all echelons of the digital brigade can begin planning and preparation very quickly, and contiguous echelons interact and collaborate digitally throughout the planning/ preparation process. Concurrent planning and preparation across multiple echelons are becoming common, changing the nature of the handoff from planners to executers.

Examples of the benefits of digitization during the planning and preparation phases have been found at Fort Hood and at the NTC. A hypothetical illustration follows. The brigade, after completing a defense in sector, is given at 2000 hours a mission to attack at 0600 hours the following morning. The brigade commander and staff meet (doesn't have to be face to face) for initial guidance and coordination. The brigade commander gives his guidance for his intent. Staff personnel develop graphics and concise instructions for the subordinate units. This information is digitally transmitted to the units by 2030 hours. The brigade commander using his digital tools determines the best location (he knows where the key members are) to meet with them. While the unit's leadership is meeting to confirm their missions and the commander's intent, the subordinate units are moving into assembly areas for the attack. Companies and platoons have information of the next day's operations prior to midnight. Following the one-third/two-thirds rule they would not have gotten it prior to 0300 hours. By 0300 hours they are already in their assembly areas refueling, rearming, doing pre-combat checks, etc. Though a notional example, such events did occur in the timelines described. Without digitization such an exercise would never have been considered, much less attempted. It was simply not possible to move at night over the terrain (especially at the NTC), much less do it in the timelines described, without digitization. Digitization capabilities enabled navigation, movement, control, linkup of units, resupply linkups, and organization of assembly areas all of which were crucial to conducting such an exercise.

Analysis and visualization of several COAs is the norm. Historically, units normally considered one and at most two COAs for a mission. There simply was not enough time and resources to do otherwise. Although digitization has not made planning (the formal MDMP) any faster, it has improved flexibility, precision, and synchronization. Digital tools, especially the BPV as it has matured, enable commanders and staffs to develop and wargame multiple COAs. It provides the brigade commander a tool to share his vision of how he expects the fight to happen with his subordinate commanders.

An example of the utility and benefits of the BPV comes from a movement to contact mission for a brigade. This mission clearly requires multiple COAs as well as branches and sequels within each COA. With the BPV tool a base plan is developed quickly. The commander and staff spend time thinking about different options the enemy has based on this base plan. This in turn leads to different COAs for the brigade. The BPV tool allows the COAs to be "run" (a hypervelocity preview of the battle) and viewed by the commander, his staff and the subordinate commanders. This enables the leadership to rehearse three completely different options—observe the enemy's actions and develop branches and sequels for what the enemy might do. The leadership has a shared vision and understanding of the brigade commander's intent and desire in a variety of situations. Because commanders can now visualize the entire battlefield with near real-time awareness, they can alter COAs far more quickly with greater effect. Battalion commanders are able to execute with much more certainty and flexibility than ever before.

Situational Awareness, Situational Understanding and Situational Dominance

The concepts of Situational Awareness (SA), Situational Understanding (SU) and Situational Dominance (SD) have been used to described levels of digital capabilities and benefits for several years. It is important to note that each is associated with levels of benefit that are available because of digitization. The first, SA, translates to an awareness or knowledge of the friendly force and the enemy within the unit's battle space. The second, SU, focuses on an understanding of what the knowledge of the friendly and enemy elements means. In the SU area the focus shifts to what the enemy can and will do, and what the friendly force can do to defeat the enemy. In SD the activity shifts to dominating the enemy. In effect, SD results from SA and SU setting conditions for destruction of the enemy. Figure 1 depicts the progressive functions associated with these concepts. For this discussion the three will be separated. However in reality they are intertwined.

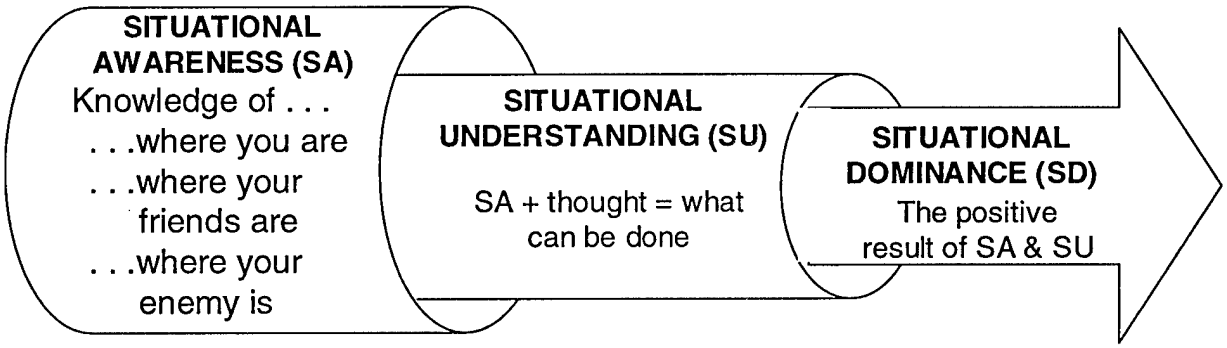

Figure 1. Depiction of the elements leading to Situational Dominance.

Situational Awareness. In the past it was often said that SA was the single greatest benefit from digitization and was worth the price of digitization by itself. In the simplest terms it means knowing where you and your buddies are. Historically, platoon leaders and to some degree company commanders stayed in sight of their elements. It was a comfort zone that most desired. With digitization visual contact is replaced with icons visually displayed on screens. Moving and maneuvering through dense wooded areas or difficult compartmentalized terrain under limited visibility is no longer a problem. In fact, it is one of the great benefits brought by digitization.

In the example cited previously in which a brigade moved in the dark over difficult terrain to assembly areas, leaders used enhanced SA to successfully control the operation. Instead of depending on a track commander's or platoon leader's ability to read a map, they relied on the same track commander or platoon leader to transmit on-line via his FBCB2. Knowledge of the precise locations of friendly vehicles eased the coordination and synchronization involved in the movement, with much less chance for congestion on the routes. Also, knowing the exact locations of obstacles greatly reduced the unit's tactical burden along with the risk.

At the battalion and brigade levels the commanders and staffs have knowledge of their subordinate elements' locations and disposition in near real time that surpasses in quality and accuracy anything that existed before. Obstacles, minefields, breaches, boundaries, and objectives are visible along with subordinate units' disposition, thereby quickly and easily providing information on compliance with the commander's intent and orders. Something as simple as getting a front line trace of the friendly force previously required voice messages from each subordinate element. Now this information may be available on a screen.

Perhaps the most amazing aspect of the brigade's transition example involved the logistic actions successfully completed in the worst of conditions. The FBCB2 was a great help in linking fuelers, ammo vehicles and M88s with elements that needed them. A similar benefit occurred with medical evacuation. The linkups happened more quickly, thereby reducing the number of simulated instances of died of wounds. . With their FBCB2 platforms, logistical personnel arrived at the proper location without the traditional battlefield confusion. This is particularly valuable when the battlefield is fluid and units move frequently.

Enemy information is an absolutely critical aspect of SA. Before digitization, lower level units habitually found the enemy by running into them. First contact included direct fires. Today, enemy information, though not complete and never perfect, is available on a digital tool's screen, thus affording lower level units a much safer way to make contact. The enemy information is based on input from a wide host of intelligence gathering assets and is analyzed and converted into intelligence information, not just data.

Situational Understanding. Here the focus shifts from where the friendly and enemy forces are to what the enemy is likely to do, and how the friendly force can defeat the enemy. Leaders must have SA and the time to analyze it to gain SU.

Fortunately, leaders are finding that digitization gives them more time to think. Commanders can more quickly determine and resolve synchronization problems. This reduces the distractions and frees up more time to think. With this time to think ("white" time) commanders are developing a greater appreciation/understanding of what can be accomplished on the battlefield. They see the enemy. They see their forces. They understand what they can do based on the situation. Commanders are more willing to take risks—to take bold and aggressive actions. Knowing where their subordinate units are, they feel confident in making critical tactical decisions. This confidence expedites the flow of the battle and enables more forceful exploitation of the situation.

One commander described an exercise in which his company, leading a battalion attack and knowing where an enemy force was, approached the area with minimal force. Once he encountered the force, he held back all but one tank. The lone tank identified nearly every vehicle in the enemy defensive position. The exact locations of the enemy vehicles were broadcast over FBCB2 thus enabling the company and the parent battalion to know where the enemy was. The information led the company and battalion commanders to believe this enemy force was separated from the remainder of the enemy units. The battalion commander directed the company to slide around the enemy element and approach its rear. The battalion then

followed the lead company. The lead company turned back on the enemy force hitting and destroying it from the rear, while the rest of the battalion drove rapidly deep into the enemy rear.

Digitization enabled the battalion commander to understand the situation. He had and took the time to ensure a clear vision of where the enemy was and what it was doing. He appreciated that he could get behind it and attack from the rear, while the majority of his force proceeded deeper into the enemy's rear. By historical standards, this may be seen as bold and aggressive action. Perhaps digitization will enable this to become the standard.

Situational Dominance. The outcome of the example above typifies SD. Because of the battalion commander's SU he established dominance over the enemy, destroying the force immediately to his front and putting himself in position to attack the weakest part of the enemy force, its rear elements. Digitization alone will not enable SD. But, it enables the conditions to be set for a well-trained and proficient force to destroy the enemy.

Another example of how digitization provides SD benefits lies in the paradigm of killing the enemy deep in the battlespace. The ideal is to kill as much of the enemy as possible so that the direct firefight, if it has to occur, is against an enemy that is no match for the friendly forces. This is possible through the use of Joint Surveillance Target Attack Radar System, Unmanned Aerial Vehicles, Army Aviation, Multiple Launch Rocket System and cannon artillery, and the Brigade Cavalry Troop. These systems must be linked digitally to provide targets, battle damage assessments, and protection of valuable indirect fire assets and to track the battle as it nears the friendly maneuver forces. The synchronization required to execute this successfully on a dispersed battlefield can only be done with digital tools. When executed properly, the friendly forces find themselves in a position to attain situational dominance.

SD is very action oriented. Tulak and Hutton (1998) point out that achieving SD requires shaping the battlespace. One of the early digital leaders described the flow from SA to SU to SD quite well and succinctly (TRW, 1999b). "Awareness is 'I know where everybody is, got it.' Situational understanding is 'I understand what that means, everybody being where they are and where the Red Force is and what they might be able to do me'. It's not just that I'm aware, but that I understand the implications of it. Dominance is acting so that the result absolutely overwhelms the enemy."

Digitization Challenges

Personnel with extensive experience using digital systems identified a number of problems or needs to be addressed to support the effective use of digital systems. In certain cases the product or policy change needed is fairly clear. In other cases, technical issues need to be addressed to better define the needed product or change.

Digital systems are seen initially as a tax. Soldiers and leaders have not seen any reduction in workloads, only the increased requirement to learn and train in their digital platforms. The company commanders felt going digital doubled their workload. As one commander stated, "I know it (digital systems) can do a lot more than what I originally expected. I also know it's a lot more labor intensive to maintain and train on than I had any idea before." Because of a lack of proficiency, they did not trust the system. During field exercises, they kept

an analog map in addition to using the digital systems. They felt they had to copy acetate overlays to match the digital overlays. Digital training took excessive energy in the field environment. The systems unrealistically forced workarounds for problems. These workarounds took more time and energy to make the digitization process work than it seemed worth. It took a great deal of energy to make the platoon leaders use the systems. Not until the units achieved digital proficiency did their new systems stop being a burden.

There continues to be a lot of frustration with digital systems at all levels. Software drops that come too frequently—with characteristic instability and without sufficient training—fuel this frustration. Soldiers become confused on the capabilities of the system. When they become confused or frustrated, they lose confidence and trust in their system. Soldiers need to use one version of software for an extended time period, and not have software drops every other month. Most interviewees desired that software updates should be done every 18 to 24 months, after there have been significant changes and sufficient software testing. Then, and only then, should modified systems be installed and soldiers trained.

Leaders need to know how to bring FBCB2 on-line. Leaders at brigade and battalion level need to know what operationally needs to be done to ensure their unit's FBCB2 is "up" and higher headquarters has all the leader's subordinate element's icons on their FBCB2 screens. It is important that leaders at all levels recognize transmission and propagation details for themselves and subordinates. Understanding this aspect of digitization management encourages trust throughout the organization and validates for subordinates that the leaders are interested in digitization at the individual platform level. Soldiers recognize that transmitting means "I know where you are."

Leaders must learn how to manage and group icons to fit variations in tactical situations. Leaders must understand what they're seeing on their screen. An icon indicates general location if filters are set to aggregate higher than the platform level, because the icon aggregates the individual platforms to show the formation's center of mass. Leaders must know how and when to aggregate and deaggregate icons to optimize command and control in the current tactical situation.

Leaders must consider the cost of information in digital operations. The human burden of dealing with on-demand battlefield data becomes a special concern. With the high volume of information available on digital systems, commanders and staffs must manage closely the acquisition, processing and flow of critical information. Selectivity in acquiring information takes on added importance, compared to analog operations. Deliberate procedures are needed to control the analysis and flow of digital data. Units now assign special importance to information management in their SOPs. It may be significant that none of the warfighters interviewed by the research team voiced concern about information overload.

Brigades need resident troubleshooting capabilities. Leaders at brigade and below levels reported a lot of frustration at not being able to determine system faults. When various systems "crashed" leaders were at the mercy of finding the one or two soldiers in their units or contractors who could remedy the malady and bring their system back on-line. Often the correction would take only a couple of minutes where leaders had waited up to an hour to get the

"expert" to their system or box. There is an apparent need for operator training on troubleshooting procedures. Currently operators have to fix problems by trial and error, or by tracking down an S6 representative. Operators have developed workarounds, learned what causes some problems and learned how to avoid problems. The operators have an understanding of the basics of their systems, but want to know how to do some basic troubleshooting.

ASAS operators need more warfighting skills. One ASAS operator was directed by his S2 to be more of an analyst. But, he did not know and could not anticipate what the battle captain needed or wanted. He wanted to be more involved in the battle process. Another operator stated, "I would like to know what the battle captain needs, instead of him having to tell me. If I knew, then I would have it for him when he needed it, saving time and trouble."

Digitization brings with it additional training requirements. Digitization does not reduce the training load. Digital units have more tasks to train, more complex subjects to train, and suffer from high atrophy of the skills once they are trained. Units are not receiving any more time or resources to accomplish the additional training load. There are fewer soldiers in digital divisions to accomplish the essential tasks.

Procedural digital skills, because they are perishable, must be trained repeatedly and often. Lynch (2001) earlier pointed out that digital skills are highly perishable. Certain of the leaders we interviewed for the current project had suggestions for addressing this problem When in garrison, units need to train with their systems. There should be training time scheduled routinely for soldiers to use their systems. Leaders should be proactive and creative in this training. When a detail uses a vehicle that has FBCB2, the soldiers could create an overlay of the route they are taking, their non-commissioned officer in charge could track them on another system, and they could send SITREPs or other messages back and forth. When a unit has a maintenance day, they need to do preventive maintenance checks and services on their digital systems. Training on digital systems requires priority, allocated time, a tactical scenario, and leader involvement.

It is the procedural skills rather than the more cognitive oriented skills that are believed to be highly perishable (Wisher and Ellis, 1999). For example, the procedures for troubleshooting connectivity problems with digital systems would be expected to be highly perishable, while the skills directly involved in using digital displays to control the movement of a unit may be retained for long periods of time.

Soldiers have articulated training shortfalls. Soldiers know that they would like to have more diagnostic training on their systems. Soldiers have been trained and understand how to bring their system on-line, pass free text messages, send overlays, receive and send reports—but they lack the nuances of their system about how it interacts with other systems. They were taught the tasks, but lacked the refresher training and practice to maintain skill performance standards. Leaders know that they would like to understand the basic capabilities and problems associated with each system. They also want to understand the architecture and interface of various systems at their unit or staff level.

Units have trouble updating their SOPs to reflect lessons learned with the digital systems. Review of brigade SOPs highlighted the challenges associated with maintaining digital currency. Unit SOPs do reflect the synchronization required between the units, i.e., the ability of the units to digitally communicate with each other. However, although most units had created procedural changes and written policies to accommodate their digital systems, few had documented the details in digital SOPs. Units with SOPs performed digital tasks better than those without digital SOPs. Unit SOPs are a major requirement for the success of the digitization process. Those warfighters interviewed agreed to the importance of having a written SOP but blamed lack of time, unstable software, lack of guidance, and other reasons for not maintaining digital SOPs. With the frequent changeover in positions, there is very little evidence of the transfer of digital knowledge and skills. This is where the necessity of maintaining SOPs becomes apparent. It is worth noting that when AFATDS software changes were separated by lengthy periods, artillery leaders were able to develop digital SOPs. With emphasis by commanders on capturing digital changes in SOPs, transition within the digitized units should become easier.

Digitally grounded basic soldiering skills must emerge. One 1SG stated, "We're here to be infantrymen, not here to do digitization." But in preparing for the FBCB2 Limited Users Test (LUT), the 1SG and his soldiers learned that using digitization was part of being a mounted infantryman in the 21st century. They realized the benefits of digitization and accepted it. The status of each digital system is included in unit accountability reporting every morning at stand-to. As more units become digitized it becomes a way of life for the soldiers. As units learn to use digital systems, the high-tech devices become regular items of military equipment that are required for the unit to function at peak performance levels. The NTC success achieved by the 2nd BCT during DCX Phase I highlighted the advantages of mastering digital systems. At a broad level there are predictable patterns regarding changing attitudes of digital warfighters. Positive experiences using digital systems are important in promoting acceptance of digital systems, and positive experiences, in turn, are dependent upon gaining a certain level of proficiency using digital systems. Redefining basic soldiering skills to encompass the operation and use of digital systems can help units cope with the digitization process in the future.

Digital systems do not lessen the need for basic tactical skills and knowledge. Basic warfighting and staff skills are paramount to success in digital warfighting. Digital capabilities will not compensate for shortcomings in a warfighter's tactical or fieldcraft skills. It was noted that there are some soldiers that may never know how to navigate, with a map or digitally. Just knowing where the enemy is does not compensate for tactical ineptitude.

Lack of a standard TOC challenges commanders and staffs. The team found there is no standard TOC for a 4ID brigade. Commanders (1st BCT and other brigades) used their TOCs differently in controlling the information flow. The modified TOCs were associated with some success during 4ID NTC rotations. Were their differences in performance based on TOC management? Would a standard configuration help some commanders and hinder others? We only know that the management drives the volume and pace of information flow within and out of the TOC. Battle captains had different roles in each TOC. The roles of battle captains and the rest of the staff evolve with the TOC. Without standardization their roles are different from unit to unit. One staff officer said, "If the Army doesn't come to some kind of understanding as to how to use that information and what the flow looks like, then every person that comes to an

organization will start at ground zero. Based on personalities of the command, each TOC could evolve into its own method of operation. Ten years ago every TOC was standardized. I knew what it looked like. Now, there are no rules. Training will always be at the beginning of the learning curve, every summer, when the Army changes out its organizations."

Digitization may encourage micro-management of subordinates. Not all aspects of knowing where everyone is located on the battlefield are seen as positive. Junior leaders report their commander was watching their moves and "helping" them to do their jobs or fight their battles. SA permits commanders to see what subordinate elements are doing in real time, and to direct actions at lower levels. Company commanders believe that this lessens their authority to fight their fight. One company commander expressed his concerns when he said, "Light infantry platoon leaders have more autonomy than mechanized company commanders. Now with the digital stuff, we have even less autonomy because the battalion commander and brigade commander look at their screens and can look at my company's formation. Even though I'm aware that, yes, indeed first platoon is going the wrong way and I'm trying to fix it, I have the brigade commander hopping down on the battalion command net, and saying you better unscrew Charlie company right now. On the one hand yes, maybe it makes us more combat effective. But on the other hand, it takes away a lot from company commanders. To top that, I do it to my platoon leaders, too." Lynch (2001) reminds us that micro-management by leaders will have a disastrous effect.

Apparent tendencies toward micro-management should be viewed in the context of multiple factors. What looks like micro-management to a subordinate may really be a higher commander seeking information or verification. And a higher-level commander with access to more complete ABCS information may be in a better position to make certain lower-level decisions (Harris, 1999). On the other hand, Harris (1999) also points out there are times when a commander at a particular location has a better grasp of the situation then does someone viewing the action from a display.

Call for fire procedures are unresolved. Digital systems enable anyone with an FBCB2 system to call for fires. Alternative procedures are now required at unit levels to avoid fratricide. Fratricide has been an issue at the NTC. Some units have gone to an analog/digital SOP that requires individual clearance up and down the chain of command. Others have limited clearance of fires to company commander levels. Unfortunately, this weakens the digital time advantage offered by AFATDS/FBCB2. Digitization is changing how the brigade manages indirect fires (Leibrecht et al. in preparation). Laser range finders on tanks and Bradleys give each vehicle the capability to initiate accurate FBCB2 calls for fire. The role of the Fire Support (FIST) is shifting to a focus on managing calls for fire against the commander's priorities.

Digitization has expanded the challenges in controlling fires. In analog units indirect fire support is a very controlled process. However, any digital platform has the capability to call for fire. Additionally, often there are more targets than can be serviced. Digital fire control processing can bypass historical control procedures. The potential is greater for fires to become uncontrolled. Because of this some battalion commanders limit the authority to call for fire to the company commander and Fire Support Team. The company commanders are responsible and may request fires via voice or digital means. A company commander has control of his

vehicles through FBCB2. When all vehicles are broadcasting and the commander has the SA on his screen, he can determine that all vehicles are outside the impact area and he can call for fire. If they are within the impact area, the commander should not call for indirect fire. The commander must also have control measures in place to maintain boundaries and control vehicles that are not broadcasting. These procedures should be documented in TTPs or SOPs. An additional concern for fires on the digital battlefield is the tracking of scouts. The scouts that are dismounted are not tracked by FBCB2. For their specific locations to be tracked they must use voice and report. Scouts are required to maintain radio contact and be within 500 ft of their vehicles broadcasting on FBCB2 to decrease the threat from both friendly indirect and direct fires.

Automated input may cause lower level leaders to define less ownership of plans. Digital systems now automatically gather much of the information required during the planning process. This is especially true for information regarding status of forces (e.g., location, logistics status). As digital systems perform more information gathering and processing, company and platoon warfighters (executers) may become less involved in such functions. Reduced involvement could lead to a diminished sense of ownership of tactical products.

Summary of Findings

Table 2 summarizes the collective findings of the project. The summary necessarily sacrifices the examples and implications provided in the discussion.

The research team completed an assessment of the changes in attitudes, behaviors, and knowledge of units fielded with digital tools. The assessment process sampled warfighters with systems experience from commanders to operators. The overall judgment was that acceptance of the systems was enhanced as training progressed and more hands-on experience was gained in a tactical environment. The more warfighters learned, the more they wanted to know.

The collective findings are expected to support efforts to facilitate the employment of digital systems, as more of the Army transitions to digital operations. As digital challenges are addressed, one might expect two impacts relevant to the findings of this report. First, the probability that a particular unit will demonstrate the positive behavior changes described in this report should increase. Second, new and positive behavior changes can result from actions that address the digital challenges noted.

Table 2

Summary of Project Findings

Area	Topic	Finding
Positive Changes In Unit Behavior	Command emphasis	Command emphasis fosters positive attitude changes that facilitate digitization.
	Motivating system use	A commander's reinforcement of digital broadcast rates can motivate use of systems.
	Means of control	Commanders rely on voice and face-to-face communication, as well as digital, to guide and control their subordinates.
	Warfighting practices	Digital capabilities prompt commanders to change their tactical thinking, altering the way they fight..
	Tactical movement	Units use digital capabilities to improve and control tactical movement.
	PIRs	Digitization enables the commander's PIRs to be more focused and visible.
	Information appetite	In exploiting digital systems, commanders want tailored information on highly specific questions.
	Decision making	Accurate real-time information enhances the tactical decision making process.
	Risk-taking	Digital commanders become more willing to take risks as a result of greater confidence.
	Control of operations	Commanders use situational awareness tools to enhance control of tactical operations.
	Low-visibility operations	Situational awareness capabilities provide a warfighting advantage in reduced visibility operations.
	Logistics functions	Digital tools improve logistics functions, especially coordination and synchronization.
	Time to think	Fewer synchronization problems means commanders have more time to think.
	Multiple COAs	Digitization enables planning for multiple COAs, to include wargaming and rehearsals.
	Situational understanding	More accurate and timely battlefield visualization produces better SU.
	Boldness	Digital capabilities enable commanders to take bold, aggressive actions.
Positive Attitudes	User confidence	Familiarity and proficiency bring confidence in digital capabilities.
	Role of experience	Confidence in digital systems increases as digital skills become integrated with warfighting skills.
	Warfighter trust	Trust in digital systems comes with experiencing their benefits.
	NTC appreciation	Warfighting experience at the NTC reinforced the value of digitization.
	Value of location icons	Having accurate friendly/enemy location information accounts heavily for system use.
	Career value	Digital acceptance, skills and knowledge sustain career progression.
Benefits of Behavior Changes	Allocating planning time	The long-standing one-third/two-thirds rule for allocating planning time is no longer appropriate. Simultaneous, collaborative planning across echelons is emerging.
	Developing COAs	Shared visualization is making development and analysis of multiple COAs the norm, with branches and sequels.
	Situational dominance	Digital systems' SA capabilities enhance SU across the unit. More forceful and timely exploitation of the battle space produces situational dominance.
Digitization Challenges	Initial burden	Leaders and soldiers view digital systems as a tax until they develop basic proficiency.
	Frustration	Frustration with changing software undermines confidence in digital systems.
	Leader knowledge	Leaders must know how to optimize FBCB2 capabilities.
	Managing icons	Leaders must know how to manage and group icons to meet specific needs.
	Cost of information	The cost of information takes on special importance in digital operations.
	Troubleshooting	Digital operators at all echelons need troubleshooting skills.
	ASAS operators	ASAS operators need expanded warfighting skills to fully support the MDMP.
	Training requirements	Digitization brings additional training requirements.
	Perishable skills	Procedural digital skills must be trained repeatedly and often to avoid atrophy.
	Training shortfalls	Soldiers and leaders have identified training needed to exploit their digital systems.
	Digital SOPs	Up-to-date SOPs are critical, but units find it difficult to keep them current.
	Soldiering skills	Basic soldiering skills must be redefined, as use of digital systems becomes routine.
	Role of digital systems	Digital systems do not lessen the need for basic tactical skills and knowledge.
	Non-standard TOCs	Lack of a standard TOC leads to unit-specific battle staff procedures and info flow.
	Micro-management	Digital capabilities may encourage commanders to micro-manage subordinates.
	Calls for fire	Digitization has raised issues for preventing fratricide that are yet to be resolved.
	Control of fires	Digital capabilities expand the challenges for controlling indirect fires.
	Impact of automation	Automated input may cause lower level leaders to define less ownership of plans.

RECOMMENDATIONS AND CONCLUSIONS

Recommendations

Research efforts should continue to expand the baseline digital database and share that information. One major void in our knowledge is the amount of effort required to train various digital applications or skills. For example, do platoon leaders immediately learn how to control the movement of their platoon using the information in SA displays, or is this a skill that requires practice and feedback? Another major void in our knowledge concerns how experience using digital systems can help units reduce problems in the mission planning process. For example, descriptions of trends in the performance of pre-digital units at maneuver combat training centers show orders frequently contain gaps in the details of plans, and one might wonder whether the ability to share an evolving plan electronically reduces the frequency with which this problem is encountered (Barnett and Meliza, 2001).

As more units are fielded with digital systems, the opportunities to extract valuable information will become easier and less invasive. The growth in the number of digital platforms should reduce the volume of research efforts being conducted in any one organization. This should help alleviate the difficulties the team encountered, ostensibly because of "research saturation," which limited the opportunities to obtain most current information. With more units digitized, there will be a wider band of access for information.

Suggested Army Actions

The leadership of the U.S. Army must continue to resource fully the digitization training efforts in TRADOC and field units. Some specific actions the Army should consider in its promotion of digital systems include:

(1) Limit the frequency of software changes.

(2) Ensure that changes in software versions are tied to specific spiral development objectives.

(3) Synchronize digital training with personnel assignments to digitized units.

(4) Develop and field standardized TOCs, with digital battlestaff TTPs.

(5) The Army training centers should ensure that programs of instruction cover baseline digital tasks. A preliminary list of tasks follows:

(a) Train digital skills as basic soldier skills.
(b) Address digital troubleshooting techniques.
(c) Provide operators and users with information about how to identify and protect the digital network from malfunctions and common operator errors.
(d) Provide operators and users with an understanding of the interfaces among systems

and "where the data comes from."

(e) Address job-specific benefits of employing digital systems.

(f) Address techniques for electronic distribution of large files like overlays.

(g) Make sure operators/users know where data or function redundancies exist across systems.

(h) Help operators determine when a system is about to crash, to include frequent causes of digital systems crashing.

(i) Help operators/users decide when and how to employ filters for aggregating icons.

(j) Make sure operators know how to digitally join a network.

(k) Address the physical, digital and functional architecture of brigade and battalion command posts.

(l) Describe monitoring activities that should be performed at each echelon (e.g., what should an armor platoon leader observe to monitor performance of his unit as it performs a passage of lines)

Suggested Unit Actions

The 4ID as the U.S. Army's FDD has made tremendous strides in digital training and provided an initial baseline for further study. Every soldier interviewed expressed training as the number one priority of the digital environment. Many training tasks should be conducted at Army schools and reinforced at unit level. Every interviewee expressed a desire to receive digital training by a certified instructor as soon as they are assigned to a digitized division. This training should be conducted as a part of in-processing at the installation before unit assignment. With digital equipment being the mainstay of division communication, all soldiers should receive an overview of equipment within the division.

Other unit actions are required to promote and support the use of digital systems:

(1) Units should stress more sustainment training and use of digital systems on a day-to-day basis.

(2) Unit tactical SOPs must reflect employment tactics, techniques, and procedures of digital systems.

(3) Higher headquarters should ensure that digital SOPs for the various subordinate units are compatible.

(4) Any soldier assigned to a specific duty position where he will be required to operate a certain system, like a Maneuver Control System operator in the S3 section or ASAS operator in the S2 shop, should receive systems training.

(5) Staff non-commissioned officers and officers should be trained on architecture and troubleshooting of the systems they have in their command posts.

(6) One or two master-trainers in each company/troop/battery should be capable of conducting initial training, sustainment training, and troubleshooting until formal training can be scheduled. They should be able to develop training and practical exercises and supervise them.

(7) Leaders should be trained on the overall capabilities of the systems so they can utilize those capabilities in planning and fighting on an extended battlefield.

(8) Make sure work around procedures are combat realistic (rather than just meeting the need for a training exercise).

(9) Establish TOC set-up procedures and provide procedures for establishing and moving a digital TOC.

(10) Clarify the role of a battle captain in task force and BCT TOCs.

(11) The chain of command should treat digital skills as basic soldier skills.

(12) Unit policies should enforce and reward the use of digital systems.

Digital Proficiency Indicators

In addition to the above recommendations several baseline indicators of digital proficiency are identified for further exploration and possible measurement. These represent near-term targets for digital units and are listed below:

(1) Most or all platform-level digital systems are operational and broadcasting platform location. Users know how to log into the network and how to maintain and recognize their broadcast properties.

(2) Units employ digital backups rather than regressing to analog procedures.

(3) Operators and users are more aware of information and function redundancies across systems.

(4) Problems navigating units/platforms disappear.

(5) Operators successfully troubleshoot major system failures.

(6) Operators and users know and diagnose major points of failure for their system (fewer system failures).

(7) Vehicle commanders are able to navigate to specific locations.

(8) The commander's PIRs are focused and widely visible.

(9) Digitization impacts planning processes (more time for commanders to think, more options, use of digital tools to determine COAs, and utility of overlay distribution).

Conclusions

The findings revealed a systematic evolution of behaviors, knowledge, and attitudes accompanying the units' transition to digital systems and operations. Initial resistance and reluctance give way to confidence and trust in digital systems as leaders and soldiers acquire basic digital proficiency and then learn how the new technology improves their warfighting process. Digital capabilities alter the way warfighters think and fight, and the operational changes find their way into procedural documents. As digitization progresses, leaders make bolder decisions due to improved battlefield visualization and SU. Planning, preparation, and execution of combat missions benefit from digital advantages. In parallel, the training environment evolves to support digital operations and readiness.

- As a general rule, individuals appear to adapt to digitization in an orderly sequence of stages: (1) initial skepticism and reluctance, (2) understanding of system capabilities, (3) proficiency with new systems, (4) understanding of benefits, (5) confidence and trust in the systems, and (6) reliance on digital capabilities. As soldiers become comfortable with digital systems, they gradually see themselves as *digital* warfighters.

- Warfighters can be expected to view digitization as a tax at the start. Until basic digital proficiency is achieved units may experience greater workload. Synergy between warfighting and digital skills takes time to develop.

- Forceful leadership is needed to facilitate the transition to digital operations. Leaders set the conditions for success by communicating their expectations, mandating where necessary, shaping and reinforcing subordinates' behavior, and enforcing operating procedures.

- SA is one of the most positive aspects of digitization. Battlefield visualization leads to better SU at all echelons. More accurate information, especially on the enemy, boosts leader confidence.

- Enhanced SU enables commanders to conduct bold, aggressive maneuvers with greater willingness to take tactical risks. Digital capabilities empower units to maneuver and engage the enemy when and where the commander chooses. The advantages are especially significant in limited visibility conditions.

- Digital capabilities give the commander and his staff more time to think and analyze. The enhanced capabilities improve planning, decision-making, and synchronization. This promotes proactive operations rather than reactive.

- Digitization is altering the organization and management of the TOC, with a corresponding change in information flow.

- Digital skills of a procedural nature are highly perishable. As a result, training on digital systems must be worked into everyday activities.

- Sharing of lessons learned within the unit is imperative in the digitization environment. Special provisions may be needed for rapid sharing of information. The end product of capturing and sharing lessons learned is written SOPs with common procedures across the BCT. Frequent updating of unit SOPs is a major challenge, driven by software/hardware that changes often. It is difficult to accomplish but critical for maintaining digitization's momentum.

- Understanding of system failures for digital systems becomes imperative at the user level. Leaders must know the causes of system failures to minimize adverse operational impacts. Troubleshooting skills need to be pushed down to system operators so they can help resolve problems quickly.

The cumulative findings of this project point to a systematic framework for exploiting digital technologies from a user's perspective. As shown in Figure 2, policies set the stage for operational proficiencies, which in turn build confidence that can be measured objectively.

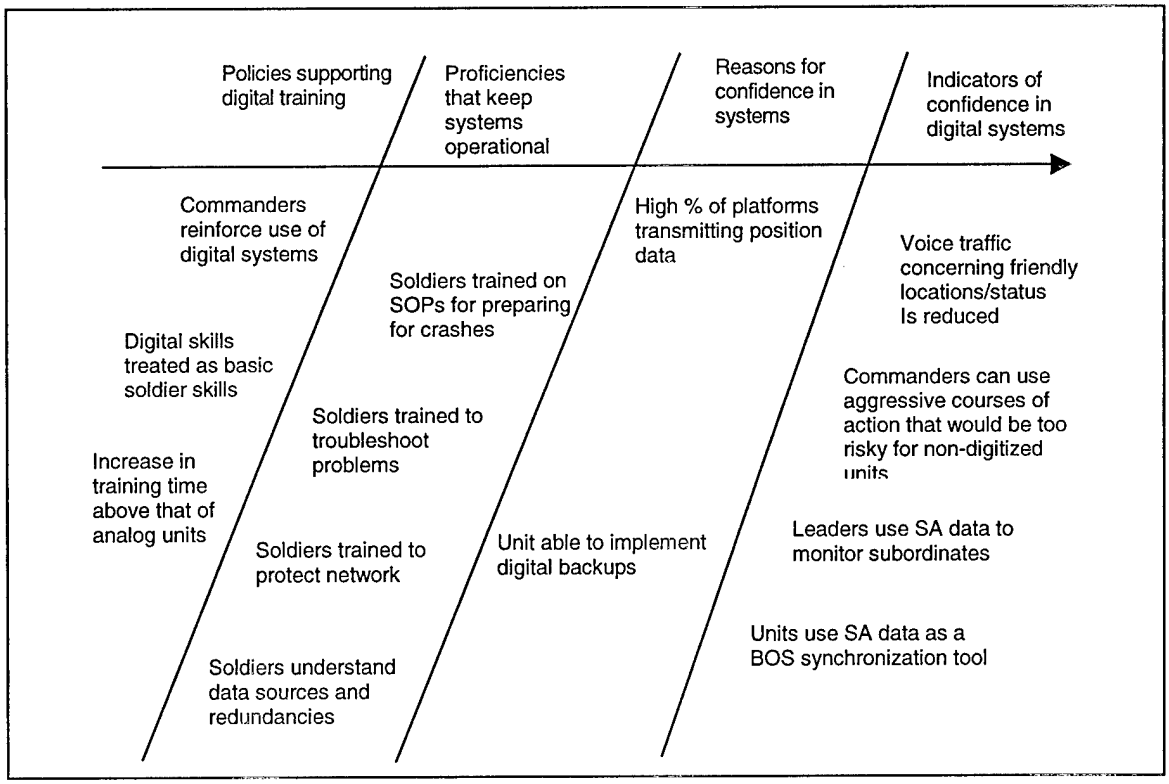

Figure 2. Framework for building and exploiting confidence in digital systems.

The insights from this research will help pave the way for measuring digital skills proficiency. However, a vast amount remains to be learned through follow-on research. Expanding the knowledge base is an important step for ensuring optimal proficiency of the digital force.

The research team is currently addressing two tasks that build upon the work described in this report. The first task is to compare battalion and brigade operations in terms of digital task and skill requirements. Among other things, this task will identify digital tasks and skills that carry over from battalion to brigade level. The second task is to begin specifying actions a unit should take in order to obtain some of the advertised benefits of digitization (e.g., what should a unit do in order to reduce the probability of fratricides?).

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APPENDIX A

INTERVIEW QUESTIONS

1. Changes in Unit Attitudes:

   a. Describe how your attitude toward fighting in the digital battle space has changed over time. Consider the following benchmarks:
      - Initial train-up assessment before the Customer Test (Mar-Apr 00)
      - Post-train-up assessment at the Customer Test (May 00)
      - Initial train-up assessment before NTC rotation (Aug 00)
      - "Hot" post-rotation assessment (Aug 00)
      - Reflective assessment (Apr 01))

   b. What attitude or behavioral changes are fundamental to becoming a digitally trained team? Address the following echelons, as appropriate:
      - Platoon
      - Company
      - Battalion
      - Brigade

   c. What was the role of digitization in the NTC? What value did digitization bring? How could that value have been enhanced?

2. Meeting Digitization Challenges:

   a. What problems did your unit face in using digital systems?

   b. What changes did your unit make to address these problems?

   c. Did your unit use SOP development, staffing changes, or new TTPs to support the use of digital systems? How?

3. Digital Leader Tasks and Skills:

   a. What are the most important digital leader tasks that require training to achieve minimal proficiency?

   b. What leader tasks have changed on the digital battlefield for you?

   c. What basic digital skills are required to accomplish the above leader task(s)?

4. Team Training Tasks and Skills:

   a. After "knobology," what are the primary/basic digital training tasks for various teams?
      - Staff integration management
      - TOC battle command management
      - Platoon
      - Company
      - Battalion
      - Brigade

   b. What different/unique skills are required to be successful performing with digital information as opposed to analog at various levels?
      - Platoon
      - Company
      - Battalion
      - Brigade

   c. What new knowledge, skills, and abilities are required to accomplish the digital infrastructure management, operations, and maintenance tasks?

5. Exploiting Digitization:

   a. Describe the differences between digital and analog mission accomplishment and how you ensure success at your team level. What must you do differently now to exploit digitization?
      - Management of time and resources
      - Decision making
      - Understanding the Commander's intent (objectives, key information needs, empowerment)
      - Communications and information management

   b. What specific digital leader skills are necessary to exploit the advantages of digitization?

   c. How do you know a unit is 'digitally' better? How do you assess progress?

   d. What changes have you noticed, due to digitization, in terms of what you have to do or what you can do for mission planning?

   e. Do you think that digitization gives you greater access or less access to the commander, other BOS, and higher and lower echelons, or do you think it has no effect on access?

   f. Does digitization help you do your job, or does it add to the variety of activities/tasks you have to attend to?

   g. If you could have a tool that automatically tracked digital planning activities and alerted you to problems, what activities or problems would you want the tool to track?

h. Did you use digital systems to implement changes in mission planning, preparation and conduct, or do you rely more on voice or face-to-face communications?

i. Do you use digital systems (directly or indirectly) to track how well staff members are working together in planning for a mission? If so, what do you pay attention to?

j. How do you use digital systems to manage execution of the reconnaissance and surveillance plan?

k. What changes has the unit made over time to speed up preparation of the reconnaissance and surveillance plan or improve the quality of the plan? Have there been any SOPs developed about who should provide what information and when?

l. Do digital systems help the process of analyzing data? If so, how? Do they make it easier to obtain data and to disseminate the results?

m. How did your unit apply the doctrine and TTPs for digital operations?

n. Where does the doctrine or TTP appear flawed?

o. What shortfalls in digital capability exist?

p. How do soldiers/leaders overcome these flaws?

6. Digital Skills Unique to the Brigade Echelon:

   a. Are there unique digital skills at level that are not learned at lower echelons?

   b. Are those skills significantly different for any subset of the TOC? Which ones?

   c. How are those skills unique to the level?

7. Proficiency Concepts:

   a. How would you measure proficiency in the brigade-unique skills?

8. Maintaining Tactical Adaptability:

   a. What are the new digital sub-tasks required to maintain tactical adaptability at Battalion level?

   b. What skills are necessary to be successful in maintaining tactical adaptability?

   c. What skills are important in maintaining situational awareness?

d. How would you assess progress and determine proficiency in those skills? Go/no go or multi-value measures? How so?

e. Is there a different level of proficiency required at level in maintaining tactical adaptability?

9. Controlling Enemy Contact:

a. What new digital sub-tasks are required to control enemy contact at Battalion level?

b. What skills are necessary to be successful in controlling enemy contact?

c. How would you assess progress and determine proficiency in those skills? Go/no go or multi-value measures? How so?

d. Is there a different level of proficiency required at level in controlling enemy contact?

10. Preventing Fratricide:

a. What new digital sub-tasks are required to avoid fratricide at the Battalion level of decision-making?

b. What skills are necessary to be successful in avoiding fratricides? Which skills are digital related?

c. How would you assess progress and determine proficiency in those skills? Go/no go or multi-value measures? How so?

d. Are there unique digital skills required at the level to avoid fratricide?

11. What other comments do you have about digital tasks and skills?

a. If you had only five minutes to tell your replacement what he needs to know about operating in a digital environment, what would you tell him?

12. Digital Operations at the Company and Platoon Level:

a. Does FBCB2 support the control and distribution of direct fires? If so, how?

b. Do crews use FBCB2 to prepare and submit range cards? Do they view range cards as offering greater value or less value in the digital environment?

c. Are terrain analysis tools used to select or check movement routes? If so, who does the checking?

e. Is FBCB2 used in any way to deconflict routes? If so, how?

f. How do you use FBCB2 to control unit movement?

g. Do you use FBCB2 during movement prior to contact? If so, how?

h. Once you have engaged the enemy (or vice versa), do you use FBCB2? If so, how?

i. How does digitization affect or change the way you conduct troopleading procedures in your unit?

j. Has digitization changed what you as a company commander or platoon leaders emphasize during mission planning, preparation, and mission execution? Has digitization made your job easier or harder? Please explain.

k. How has digitization affected/changed the duties/activities of your track commanders during mission planning, preparation and execution?

l. Do you have a unit SOP that specifies when LOGSTAT reports are sent up by crews?

APPENDIX B

LIST OF DOCUMENTS REVIEWED

These are documents reviewed as part of the data collection effort. Copies of Fort Knox Special Manuals and Fort Knox Special Texts can be obtained through the United States Army Armor Center and School, Fort Knox, Kentucky 40121. Other documents are available from TRW Inc., 100 E. Central Texas Expressway, Suite 200, Killeen, Texas 76541.

FKSM 71-1 Digital Supplement Platoon and Company Digital Operations. Dec 1998

FKSM 17-97-10 (EXFOR) The Brigade Reconnaissance Troop. Dec 1998

FKSM 71-3-1-(EXFOR)-MTP Mission Training Plan for the FBCB2-Equipped Brigade Combat Team Post Limited Users Test (LUT)#1. 7 Dec 1998

FKSM 71-2-1-(EXFOR)-MTP Mission Training Plan for the FBCB2-Equipped Battalion/Task Force Post LUT #1. 7 Dec 1998

FKSM 71-1-1-(EXFOR)-MTP Mission Training Plan for the FBCB2-Equipped Tank and Infantry Company Team Post LUT #1. 7 Dec 1998

FKSM 71-237-10-(EXFOR)-MTP Mission Training Plan for the FBCB2-Equipped Platoon Post LUT #1. 7 Dec 1998

FKSM 71-237-10-(EXFOR)-MTP Mission Training Plan for the FBCB2-Brigade Reconnaissance Troop Post LUT #1. 7 Dec 1998

FKSM 71-2 (2005)- Armored and Mechanized Infantry Battalion Task Force TTP. Nov 1999

FKSM 71-3 (2005) Armored and Mechanized Infantry Brigade TTP. Nov 1999.

Digital Operator's Guide Company and Platoon Level (Draft). July 1999

Digital Operator's Guide for Brigade and Battalion Staffs. June 2000.

Special Text, TRADOC-ST-20-101-5 (draft). The Digitized Battle Staff Task Map, published by Warrior-T, Jun 2001.

APPENDIX C

ACRONYMS AND ABBREVIATIONS

1CD	1st Cavalry Division
1SG	First Sergeant
4ID	4th Infantry Division
ABCS	Army Battle Command System
ACT	Analysis and Control Team
ADA	Air Defense Artillery
AFATDS	Advanced Field Artillery Tactical Data System
ARI	US Army Research Institute for the Behavioral and Social Sciences
ASAS	All Source Analysis System
ASAS-RWS	All Source Analysis System – Remote Work Station
BCT	Brigade Combat Team
BPV	Battle Planning and Visualization
BOS	Battlefield Operating System
C4I	Command, Control, Communications, Computers, and Intelligence
COA	Course of Action
CSSCS	Combat Service Support Control System
DCX	Division Capstone Exercise
EXFOR	Experimental Force
FBCB2	Force XXI Battle Command Brigade and Below
FDD	First Digitized Division
FSO	Fire Support Officer

LD	Line of Departure
LOGSTAT	Logistics Status
LUT	Limited Users Test
MDMP	Military Decision Making Process
MTP	Mission Training Plan
NTC	National Training Center
PIR	Priority Intelligence Requirement
SA	Situational Awareness
SD	Situational Dominance
SU	Situational Understanding
SITREP	Situation Report
SME	Subject Matter Expert
SOP	Standing Operating Procedures
STRICOM	U.S. Army Simulation, Training and Instrumentation Command
TOC	Tactical Operations Center
TRADOC	US Army Training and Doctrine Command
TTP	Tactics, Techniques, and Procedures